U.S. Department
of Transportation

Federal Aviation Administration

Memorandum

Subject: **ACTION**: Review and Concurrence, Equivalent Level of Safety Finding for Cessna New Model 680
FAA Project #TC2548WI-T

Date: April 23, 2004

Reg Ref: § 25. 341(b)

From: Manager, Airframe & Cabin Safety Branch, ANM-115

Reply to Attn. of: T.N. Baktha, ACE-118W

To: Manager, Wichita Aircraft Certification Office, ACE-115W

ELOS Memo #: TC2548WI-T-AG-6

Background

Cessna Aircraft Company requested a finding of Equivalent Level of Safety be made with respect to § 25.341(b), "Continuous Gust Design Criteria." Cessna proposed replacing the existing continuous design critera of § 25.341(b), which does not accurately account for the distribution of turbulence in the atmosphere, and complying with the criteria contained in the proposed NPRM dated June 24, 1999, titled "Revised Requirements for Gust and Continuous Turbulence Design Loads." This proposed NPRM, the result of the harmonization of the JAR and FAR requirements, will update § 25.341(b) while maintaining and enhancing the level of safety.

Applicable regulation(s)

Section 25.341 (b) - Continuous Gust Design Criteria

Regulation requiring an ELOS

Section 25.341 (b) - Continuous Gust Design Criteria

Description of compensating design features or alternative standards, which allow the granting for the ELOS (including design changes, limitations or equipment needed for equivalency)

The criteria is based on the proposed NPRM for Revised Requirements for Gust and Continuous Turbulence Design Loads.

Continuous Turbulence Design Criteria. The dynamic response of the airplane to vertical and lateral continuous turbulence must be taken into account. The dynamic analysis must take into account unsteady aerodynamic characteristics and all significant structural degrees of freedom including rigid body motions. The limit loads must be determined for all critical altitudes, weights, and weight distributions as specified in § 25.321(b), and all critical speeds within the ranges indicated in paragraph (3).

(1) Except as provided in paragraphs (4) and (5), the following equation must be used:

$$P_L = P_{L\text{-}1g} \pm U_\sigma \overline{A}$$

Where——

P_L = limit load;

$P_{L\text{-}1g}$ = steady 1-g load for the condition;

$\overline{A}$ = ratio of root-mean-square incremental load for the condition to root-mean-square turbulence velocity; and

U_σ = limit turbulence intensity in true airspeed, specified in paragraph (b)(3) of this section.

(2) Values of $\overline{A}$ must be determined according to the following formula:

$$\overline{A} = \sqrt{\int_0^x |H(\Omega)|^2 \Phi(\Omega) d\Omega}$$

Where——

$H(\Omega)$ = the frequency response function, determined by dynamic analysis, that relates the loads in the aircraft structure to the atmospheric turbulence; and

$\Phi(\Omega)$ = normalized power spectral density of atmospheric turbulence given by——

$$\Phi(\Omega) = \frac{L}{\pi} \frac{1 + \frac{8}{3}(1.339L\Omega)^2}{\left[1 + (1.339L\Omega)^2\right]^{\frac{11}{6}}}$$

Where——

Ω = reduced frequency, radians per foot.; and

L = scale of turbulence = 2,500 ft.

(3) The limit turbulence intensities, U_σ, in feet per second true airspeed required for compliance with this paragraph are——

(i) At airplane speeds between V_B and V_C:

$U_\sigma = U_{\sigma ref} F_g$

Where——

$U_{\sigma ref}$ is the reference turbulence intensity that varies linearly with altitude from 90 fps (TAS) at sea level to 79 fps (TAS) at 24000 feet and is then constant at 79 fps (TAS) up to the altitude of 60000 feet.

F_g is the flight profile alleviation factor defined in paragraph 25.341(a)(6);

(ii) At speed V_D: $U\sigma$ is equal to 1/2 the values obtained under subparagraph (3)(i) of this paragraph.

(iii) At speeds between V_C and V_D: $U\sigma$ is equal to a value obtained by linear interpolation.

(iv) At all speeds both positive and negative continuous turbulence must be considered.

(4) When an automatic system affecting the dynamic response of the airplane is included in the analysis, the effects of system non-linearities on loads at the limit load level must be taken into account in a realistic or conservative manner.

(5) If necessary for the assessment of loads on airplanes with significant non-linearities, it must be assumed that the turbulence field has a root-mean-square velocity equal to 40 percent of

the U_σ values specified in subparagraph (3). The value of limit load is that load with the same probability of exceedance in the turbulence field as $\overline{A}U_\sigma$ of the same load quantity in a linear approximated model.

Explanation of how design features or alternative standards provide an equivalent level of safety intended by the regulation

The proposed NPRM is the result of ARAC harmonization of the JAR and FAR requirements and is consistent with maintaining and enhancing the level of safety.

FAA approval and documentation of the ELOS

The FAA has approved the aforementioned Equivalent Level of Safety Finding in Issue Paper AG-6. This memorandum provides standardized documentation of the ELOS that is non-proprietary and can be made available to the public. The Transport Directorate has assigned a unique ELOS Memorandum number (see front page) to facililitate archiving and retrieval of this ELOS. This ELOS Memorandum Number should be listed in the Type Certificate Data Sheet under the Certification Basis section. [E.g. Equivalent Safety Findings have been made for the following regulation: § 25. 341(b) - Gust and Continuous Turbulence Loads (documented in TAD ELOS Memo TC2548WI-T-AG-6)]

/s/

Signature: Franklin Tiangsing
Manager, Airframe & Cabin Safety Branch, ANM-115

Date: April 23, 2004

ELOS Originated by Wichita ACO:	Program Manager, Tina Miller	Routing Symbol ACE-117W

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